INVESTIGATION OF BACKSIDE TEXTURES FOR GENESIS SOLAR WIND SILICON COLLECTORS.

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Introduction: Genesis solar wind collectors were comprised of a suite of 15 types of ultrapure materials. The single crystal, pure silicon collectors were fabricated by two methods: float zone (FZ) and Czochralski (CZ) [1]. Because of slight differences in bulk purity and surface cleanliness among the fabrication processes and the specific vendor, it is desirable to know which variety of silicon and identity of vendor, so that appropriate reference materials can be used. The Czochralski method results in a bulk composition with slightly higher oxygen, for example. The CZ silicon array wafers that were Genesis-flown were purchased from MEMC Electronics. Most of the Genesis-flown FZ silicon was purchased from Unisil and cleaned by MEMC, although a few FZ wafers were acquired from International Wafer Service (IWS).

Configuration of Genesis-flown array silicon wafers: Every hexagonal wafer flown was uniquely identified by location within the array; however, the hard landing and subsequent break-up of wafers erased this identification.

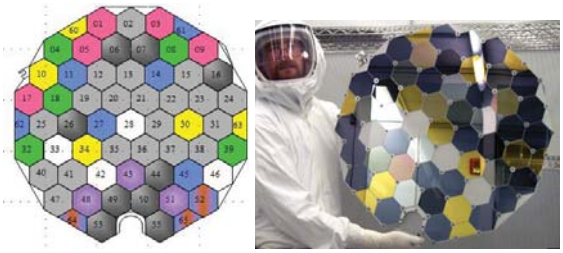

Fig. 1. (left) Pre-flight map of "B" array hexagonal collectors. Dark gray are CZ, light gray are FZ. (right) Person holding H array, for scale.

Five arrays, comprised of 301 wafer collectors, collected bulk and 3 regimes of solar wind.

Table 1. Silicon collector distribution by solar wind regime (array identifier in parentheses).

	Bulk **(B or C)**	Coronal Mass Ejection **(E)**	High Speed **(H)**	Low Speed **(L)**
CZ	27	9	7	9
FZ	37	17	17	22

Pre-flight CZ vs FZ was verified by using a gloss meter on the backside of each wafer flown. CZ wafers ranged 29-41 gloss units, Unisil FZ 50-90 and IWS FZ 90-115. These units are a measure of specular reflectance.

Diagnostic methods for distinguishing between CZ and FZ silicon: Silicon post-landing, recovered collector fragments are speciated as to CZ or FZ by using FT-IR to measure a C-O peak present in CZ.

During subdivision of a special silicon collector (the concentrator target), the backside texture was observed to be different from typical CZ. This investigation was started to see if backside textures were useful identifiers of silicon type or manufacturer.

At first it was believed that the FZ had a square texture in the backside while CZ had a more ridge texture. Backside images of nonflight CZ and FZ (Figs 2 – 4) of known manufactueres were imaged. These images were used to compare the flown samples of FZ and CZ (Figs 5 – 7). A total of 7 nonflight samples and 15 flight samples were imaged (Table 2).

Are there differences in backside texture among CZ, Unisil FZ, IWS FZ by optical images? View typical textures below.

Non-flight CZ

Fig. 2. Sample 3CZ00527.

Non-flight FZ (Unisil)

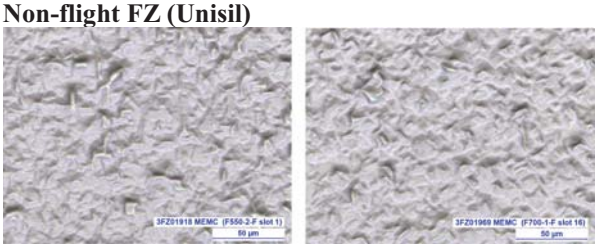

Fig. 3. (left) 3FZ01918, (right) 3FZ01969

Non-flight FZ (International Wafer Service)

Fig. 4. Sample 3FZ01938

Genesis-flown CZ

Fig. 5. (left) Sample 61287, (right) sample 61335. Both samples are Si-CZ from the bulk solar wind arrays.

Genesis-flown FZ – wrinkled texture

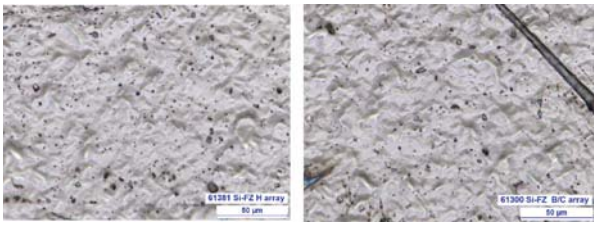

Fig. 6. (left) Sample 61381 from the high speed array. (right) Sample 61300 from the bulk array.

Genesis-flown FZ – rectangular texture

Fig. 7. Sample 61293 is from the bulk array. Backside texture is different from Fig. 6 above and similar to Fig. 4, from IWS.

Table 2. Total number of samples that were imaged from the back.

	CZ	FZ wrinkled	FZ rectangular
Non-flight	**1**	**3**	**3**
Flown	**8**	**6**	**1**

Conclusion: The preliminary images suggest that CZ and Unisil FZ are similar, but perhaps subtle difference can be discerned with more work. However, this limited sampling suggests that IWS FZ samples can be distinguished from Unisil FZ.

References: [1] Jurewicz A. J. G. et al (2003) *Space Sci. Rev*., **105**: 535-560.